A. Sirenka
Research supervisor: P. P. Korniychuk,
Candidate of Physical and Mathematical Sciences,
Associate Professor
Zhytomyr Ivan Franko State University
Language tutor: O. E. Kravets
PhD (pedagogical sciences),
Associate Professor

THE UNEXPECTED MATHS BEHIND VAN GOGH'S "STARRY NIGHT"

One of the most remarkable aspects of the human brain is its ability to recognize patterns and describe them. Among the hardest patterns we have tried to understand is the concept of turbulent flow in fluid dynamics. As difficult as turbulence is to understand mathematically, we can use art to depict the way it looks.

In June 1889, Vincent van Gogh painted the view just before sunrise from the window of his room at the Saint-Paul-de-Mausole asylum in Saint-Rémy-de-Provence, where he had admitted himself after mutilating his own ear in a psychotic episode. In "The Starry Night," his circular brushstrokes create a night sky filled with swirling clouds and eddies of stars.

Van Gogh and other Impressionists represented light in a different way than their predecessors, seeming to capture its motion, for instance, across sun-dappled waters, or here in star light that twinkles and melts through milky waves of blue night sky. The effect is caused by luminance, the intensity of the light in the colors on the canvas.

The more primitive part of our visual cortex, which sees light contrast and motion, but not color, will blend two differently colored areas together if they have the same luminance. But our brains' primate subdivision will see the contrasting colors without blending. With these two interpretations happening at once, the light in many Impressionist works seems to pulse, flicker and radiate oddly.

Sixty years later, Russian mathematician Andrey Kolmogorov furthered our mathematical understanding of turbulence.

Experimental measurements show Kolmogorov was remarkably close to the way turbulent flow works, although a complete description of turbulence remains one of the unsolved problems in physics.

A turbulent flow is self-similar if there is an energy cascade. In other words, big eddies transfer their energy to smaller eddies, which do likewise at other scales. Examples of this include Jupiter's Great Red Spot, cloud formations and interstellar dust particles.

In 2004, using the Hubble Space Telescope, scientists saw the eddies of a distant cloud of dust and gas around a star, and it reminded them of Van Gogh's "Starry Night."

This motivated scientists from Mexico, Spain and England to study the luminance in Van Gogh's paintings in detail. They discovered that there is a distinct pattern of turbulent fluid structures close to Kolmogorov's equation hidden in many of Van Gogh's paintings. The researchers digitized the paintings, and measured how brightness varies between any two pixels. From the curves measured for pixel separations, they concluded that paintings from Van Gogh's period of psychotic agitation behave remarkably similar to fluid turbulence.

While it is too easy to say, Van Gogh's turbulent genius enabled him to depict turbulence. It is also far too difficult to accurately express the rousing beauty of the fact that in a period of intense suffering, Van Gogh was somehow able to perceive and represent one of the most supremely difficult concepts nature has ever brought before humankind and to unite his unique mind's eye with the deepest mysteries of movement, fluid and light.

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